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Preliminary report not for publication[1]

MILLING, BAKING, AND CHEMICAL EXPERIMENTS WITH HARD RED SPRING WHEAT 1957 CROP[2]

by

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1/ This is a progress report of cooperative investigations containing data, the interpretation of which may be modified with additional experimentation. Therefore, publication, display, or distribution of any data or any statements herein should not be made without prior written approval of the Crops Research Division, ARS, USDA, and the cooperating agency or agencies concerned.

2/ Cooperative investigations of the Crops Research Division, Agricultural Research Service, and the Grain Division, Agricultural Marketing Service. The samples were obtained from the cooperative experiments with the State agricultural experiment stations in the spring wheat region.

Plant Industry Station
Beltsville, Maryland
CR-25-59

INTRODUCTION

Samples of the standard varieties and many of the new strains of hard red spring wheats grown in cooperative experiments in the spring wheat region of the United States 3/ are milled each year by the United States Department of Agriculture and flours baked into bread to determine their quality characteristics.

The baking methods and techniques used on the 1957 crop were essentially the same as those used in similar work for the 1944 to 1956 crops, inclusive, and described in previous reports.

The purpose of this report is to make available to cooperators the quality data on standard varieties, new strains, and commercial hard red spring wheat from the 1957 crop.

SOURCE OF SAMPLES

Tests were made on composite and individual samples of the uniform varieties and of many other varieties and strains grown in plot experiments at cooperating stations. These included samples grown at Madison, Wis.; Crookston and Morris, Minn.; Langdon, Minot, Williston, Fargo, Dickinson, Edgeley, N. Dak.; and Creston, Mont. Similar tests were made on Eastern and Western composites of the 24 strains of wheat grown in the uniform regional nurseries and on the wheats from the station nurseries in South Dakota, Wisconsin, and Montana.

There were also included 29 samples composited from samples of carlot receipts of wheat accumulated during a 90-day period of the 1957 crop movement by the Minneapolis, Duluth, and Great Falls offices of the Grain Division, Agricultural Marketing Service. These samples represent country-run receipts of the class Hard Red Spring Wheat and included only those lots that were graded No. 4 or better under the Official Grain Standards of the United States. These hereafter are referred to as commercial samples. This is the nineteenth season that such samples have been collected and tested.

3/ Ausemus, E. R. Results on spring wheat varieties grown in cooperative plot and nursery experiments in the spring wheat region in 1957. U. S. Department of Agriculture, Agricultural Research Service, Crops Research Division, CR-19-58, 69 pp. University Farm, St. Paul, Minn. (Processed).

METHODS USED IN THE CHEMICAL, MILLING, AND BAKING TESTS

The test weight per bushel of each sample was determined in the laboratory on dockage-free wheat. The wheat was milled on a Buhler automatic laboratory flour mill. Ten percent of the low grade flour was discarded, leaving a 90-percent patent flour which was used for the chemical and bread-baking tests. However, the flour yield data in the tables are reported on the basis of a straight grade flour (100 percent) obtained from each sample.

The hardness of the grain was determined by pearling 20 grams of dockage-free whole wheat for 1 minute in a model No. 38 Strong-Scott pearler. The amount of material pearled off, expressed as a percentage of the wheat, is called the pearling index. This index has been found useful, not only as a guide in tempering the samples for milling, but also as a measure of the hardness of the grain. A low index figure indicates hard grain and a high index figure indicates soft grain.

The protein and ash contents are reported on a 14.0-percent moisture basis and the flour yield on a moisture-free basis.

Sedimentation value (wheat) was determined by the method described in Cereal Laboratory Methods, Sixth Edition (1957). The sedimentation balue is a combined index of gluten content and gluten quality and is, therefore, a rough measure of bread-baking strength. High sedimentation values are normally associated with superior bread-baking strength.

The bread-baking tests were made by a formula using 100 grams of flour, 2.0 grams of compressed yeast, 2.0 grams of salt. 5.0 grams of sugar, 0.25 grams of malted wheat flour, 3.0 grams of shortening, 4.0 grams of nonfat-dry milk and varying amounts (0 to 3 mg.) of potassium bromate. The doughs were fermented for 3 hours at 86° F. (30° C.) proofed for 55 minutes at 86° F. (30° C.), and then baked for 25 minutes at 440° F. Loaf-volume data are presented only for those loaves containing that amount of potassium bromate that produced maximum loaf volumes. In most instances the loaf having the greatest volume also had the best grain, texture, and crumb color.

Bread loaf volume must be adequate for the protein content of the flour if the variety is to be considered satisfactory. The loaf volumes are shown in the tables on an "as is" protein basis and, in addition, on an expected loaf volume basis. The expected loaf volume based on flour protein content is the loaf volume obtained from baking experiments in which the flour from 589 samples of 10 hard red spring wheat varieties was tested for the crop years 1944 to 1947. Higher "as is loaf volumes" are generally associated with superior bread-baking strength.

A check or standard flour (12.9-percent protein and 0.45-percent ash on a 14.0-percent moisture basis) was included in the baking trials with each day's test. The average loaf volume of the bread-baking tests made with the standard flour was 816 cc. and the standard error 14.6 cc. On this basis the least significant difference between 2 single bakes is 41 cc.

The quality properties of each variety with respect to crumb grain and color of the bread are shown numerically in the tables. The following scores may be used as an index for judging these two properties:

59 or below	Very poor or unsatisfactory
60 to 69	Poor or questionable
70 to 79	Fair
80 to 89	Good
90 to 99	Very good
100 and above	Excellent

Varieties or selections having loaf volumes of approximately 125 cc. less than the expected, as based on the flour protein content, are questionable; and those having loaf volumes less than approximately 200 cc. or more are unsatisfactory.

An unsatisfactory rating on one or more of the properties indicates that the variety or strain is generally undesirable for hard wheat milling or bread-making purposes except that a questionable rating on one or more of the quality properties may be balanced by other outstanding properties. The milling properties are discussed in the test and should be considered along with the bread-baking properties.

The mixogram curves made for many of the samples provide information on the dough-mixing properties of the flour milled from the strains and varieties. A very rapid curve rise to the peak showing a short mixing requirement (shown as development time in the tables) and a quick decrease in curve height following the peak, denote a lack of dough stability during mixing. In general, a gradual curve rise with a slow decline (shown as mixing tolerance in the tables) in the curve after reaching the peak indicates a dough of good stability during mixing. The results of the mixogram patterns or curves have been studied, and their significance as relating to the strain or variety is discussed in the text.

EXPERIMENTAL RESULTS

Station Plot Experiments

The quality data for the uniform varieties and other wheats grown in plots are shown in table 1.

Wisconsin - Wisconsin samples were received only from Madison. The best bread from the varieties was made from Thatcher and Conley followed by Selkirk, Lee, and Russell. Henry was lowest in quality of the named varieties. It was low in protein content which, no doubt, accounted in part for its low loaf volume. It was low in water absorption. Conley produced exceptionally good bread, and the dough-handling properties were strong and elastic.

Table 1.--Milling, baking, and chemical results for hard red spring wheats grown in replicated plots in 1957.

Variety or Cross	C.I. No.	Test weight	Pearling index value	Protein: Wheat	Protein: Flour	Flour: Yield	Flour: Ash	Absorption	Mixing time	Sedimentation value	Optimum baking method: Bromate	Optimum baking method: Loaf volume	Optimum baking method: Crumb: Color	Optimum baking method: Crumb: Grain	Expected loaf volume	Quality of dough according to mixogram tests: Development time	Quality of dough according to mixogram tests: Mixing tolerance
		Lbs.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Ml.	Mg.	Cc.	Score	Score	Cc.	Min.	Min.
Madison, Wisconsin																	
Henry	12265	56.4	27	12.4	10.8	73.6	.45	55	1.75	38	2	763	70	85	745	2.75	1.50
Thatcher	10003	53.2	18	13.8	12.3	70.4	.52	61	2.50	43	2	915	75	90	820	1.50	6.00
Lee	12488	57.7	26	14.9	13.9	70.2	.50	61	2.25	50	2	825	85	90	905	2.50	2.00
Selkirk	13100	55.3	27	14.1	13.5	72.7	.50	61	2.00	50	2	903	85	90	880	2.00	2.25
Russell	12484	57.6	26	12.5	11.4	72.7	.42	60	2.75	43	1	808	85	95	770	2.25	4.00
Conley	13157	53.8	22	14.7	13.1	72.9	.52	60	2.75	63	2	875	90	100	860	3.00	4.00
H305-2 (Henry x Supresa)		60.2	27	11.4	10.4	74.8	.49	57	1.75	33	2	748	75	100	720	2.00	2.00
H441b-15-2-2-3		59.7	26	13.2	11.7	72.0	.55	59	2.00	35	2	778	85	95	790	2.25	2.25
H441b-15-2-2-4		59.6	26	12.2	11.0	73.1	.55	59	2.25	30	2	813	80	100	755	2.50	2.25
Crookston, Minnesota																	
Thatcher	10003	58.0	26	12.5	11.9	72.6	.46	61	2.75	38	2	830	85	90	800		
Lee	12488	57.2	31	11.7	10.8	74.8	.43	60	2.75	35	2	743	85	85	745	5.50	5.00
Selkirk	13100	56.6	32	11.6	10.6	76.1	.45	60	3.00	34	2	748	85	90	735		
Conley	13157	57.1	30	12.1	11.5	75.9	.45	62	3.00	40	1	740	90	90	780		
Russell	12484	57.8	35	11.2	9.6	74.6	.38	60	3.50	37	2	720	90	90	685	7.25	7.50
Rushmore x Ken. Farmer	13207	59.1	29	11.8	10.8	75.5	.40	60	4.00	45	2	743	85	90	745	6.75	5.50
Ns.4021 x Ken. Farmer	13441	57.0	32	11.5	10.0	72.3	.45	63	3.25	41	1	770	90	95	705	6.50	7.50
K338AA x Ns.3880.191	13319	59.5	29	12.8	11.5	73.0	.44	63	2.50	36	2	790	90	85	780	3.00	3.00
Lee° x Ken. Farmer	13221	56.2	31	11.3	10.3	74.3	.42	62	3.00	35	1	763	90	90	720	5.75	6.25

Table 1.--(Continued)

Variety or Cross	C.I. No.	Test weight	Pearling index value	Protein: Wheat	Protein: Flour	Flour: Yield	Flour: Ash	Absorption	Mixing time	Sedimentation value	Optimum baking method: Bromate	Optimum baking method: Loaf volume	Optimum baking method: Crumb: Color Score	Optimum baking method: Crumb: Grain Score	Expected loaf volume	Quality of dough according to mixogram tests: Development time	Quality of dough according to mixogram tests: Mixing tolerance
		Lbs.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Ml.	Mg.	Cc.	Score	Score	Cc.	Min.	Min.
Morris, Minnesota																	
Thatcher	10003	54.3	31	14.6	13.0	71.2	.45	61	3.50	56	2	908	85	80	855		
Lee	12488	54.2	33	16.4	15.2	73.4	.46	63	3.00	66	2	975	90	95	965	4.25	3.50
Selkirk	13100	54.2	37	16.5	15.4	74.8	.46	64	2.75	68	2	1025	90	90	975		
Conley	13157	54.0	33	16.2	15.4	74.4	.43	64	3.50	71	2	1070	90	80	975		
Russell	12484	55.3	37	14.8	13.4	74.3	.40	62	3.75	66	1	965	95	95	875	5.25	3.25
Rushmore x Ken. Farmer	13207	56.4	36	15.5	14.3	74.6	.40	60	4.50	71	2	1025	90	90	920	5.25	3.75
Ns.4021 x Ken. Farmer	13441	52.7	36	16.3	14.7	71.9	.55	64	3.00	67	1	1050	80	85	940	3.50	2.50
K338AA x Ns.3880.191	13319	56.0	37	17.1	16.0	71.5	.51	64	2.25	60	1	1013	85	85	1005	2.75	1.75
Lee^6 x Ken. Farmer	13221	54.0	38	16.9	15.6	72.2	.47	63	3.00	66	2	1023	95	90	985	4.25	2.00
Langdon, North Dakota																	
Conley	13157	57.4	30	14.8	13.4	76.0	.41	63	2.75	70	2	903	90	90	870		
Lee	12488	58.7	31	16.0	14.6	74.6	.41	65	2.50	69	2	980	85	85	940		
Selkirk	13100	56.8	33	15.6	14.4	75.0	.43	67	2.50	70	2	945	90	90	920		
Thatcher	10003	56.8	27	14.7	13.6	75.3	.44	64	2.75	70	2	935	85	85	885		
Rushmore x Ken. Farmer	13207	58.6	31	14.5	13.1	76.2	.41	63	3.50	71	2	883	85	95	860		
Ns.4021 x Ken. Farmer	13441	57.2	35	15.6	14.1	73.5	.45	64	3.25	72	2	1025	90	90	910		
K338AA x Ns.3880.191	13319	60.7	28	16.2	15.0	72.6	.46	66	2.25	68	2	978	85	90	955		

Table 1.--(Continued)

Variety or Cross	C.I. No.	Test weight	Pearling index value	Protein: Wheat	Protein: Flour	Flour: Yield	Flour: Ash	Absorption	Mixing time	Sedimentation value	Optimum baking method: Bromate	Optimum baking method: Loaf volume	Optimum baking method: Crumb Color	Optimum baking method: Crumb Grain	Expected loaf volume	Quality of dough according to mixogram tests: Development time	Quality of dough according to mixogram tests: Mixing tolerance
		Lbs.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Ml.	Mg.	Cc.	Score	Score	Cc.	Min.	Min.
								Minot, North Dakota									
Conley	13157	58.1	32	15.7	14.6	76.6	.42	66	3.00	69	2	1033	85	90	935	2.50	1.75
Lee	12488	58.3	33	16.0	14.8	73.8	.46	64	2.25	69	2	953	95	85	945	2.25	.75
Selkirk	13100	56.9	32	15.3	14.5	76.8	.45	65	2.50	69	2	980	100	95	930		
Thatcher	10003	58.7	29	15.0	14.2	74.0	.46	64	2.50	62	2	1005	95	95	915		
Rushmore x Ken. Farmer	13207	60.8	32	14.8	13.6	76.3	.38	64	3.75	72	1	968	80	85	885	4.00	2.75
Ns.4021 x Kenya Farmer	13441	58.5	34	15.0	14.7	73.8	.48	65	2.50	70	2	1015	95	90	940	2.00	3.00
K338AA x Ns.3880.191	13319	61.2	31	16.8	15.7	73.8	.47	65	2.00	64	2	1008	90	90	990	1.75	1.50
Lee[6] x Ken. Farmer	13221	58.2	34	16.1	15.0	72.6	.45	66	2.50	62	2	970	90	90	955	2.50	1.25
								Williston, North Dakota									
Chinook	13220	60.1	37	17.9	17.1	72.0	.41	64	2.00	70	2	1050	80	85	1060		
Conley	13157	60.6	35	17.7	16.4	74.1	.43	64	2.75	70	2	1170	90	85	1020		
Lee	12488	57.5	32	18.2	17.0	70.8	.49	65	1.75	67	2	995	95	95	1055		
Rescue	12435	56.6	32	17.7	16.7	71.5	.45	63	2.75	72	2	1228	80	75	1040		
Selkirk	13100	54.5	35	17.6	16.8	73.5	.43	65	2.50	72	2	1175	90	70	1045		
Thatcher	10003	57.1	34	17.8	17.2	71.5	.45	64	1.75	71	2	1183	90	80	1065		
Rushmore x Ken. Farmer	13207	59.8	35	15.9	15.5	73.4	.42	65	3.25	73	1	1073	95	85	980		
Ns.4021 x Ken. Farmer	13441	58.0	39	17.3	16.7	70.3	.52	65	2.00	73	2	1095	95	85	1040		

Table 1.--(Continued)

Variety or Cross	C.I. No.	Test weight	Pearling index value	Protein: Wheat	Protein: Flour	Flour: Yield	Flour: Ash	Absorption	Mixing time	Sedimentation value	Optimum baking method: Bromate	Optimum baking method: Loaf volume	Optimum baking method: Crumb: Color	Optimum baking method: Crumb: Grain	Expected loaf volume	Quality of dough according to mixogram tests: Development time	Quality of dough according to mixogram tests: Mixing tolerance
		Lbs.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Ml.	Mg.	Cc.	Score	Score	Cc.	Min.	Min.
								Fargo, North Dakota									
Conely	13157	58.0	29	13.7	12.7	74.6	.51	62	2.75	64	1	808	90	95	840	3.25	2.25
Lee	12488	61.0	28	13.4	12.1	73.0	.47	64	2.50	51	2	795	90	95	810	2.50	2.50
Selkirk	13100	58.6	29	13.0	11.9	75.8	.48	63	3.00	49	2	845	95	100	800		
Thatcher	10003	59.5	24	12.8	11.9	73.4	.53	64	2.75	50	2	810	90	100	800		
Rushmore x Ken. Farmer	13207	60.6	27	12.4	11.6	74.9	.44	63	3.25	59	2	803	90	100	785	3.50	4.50
Ns.4021 x Ken. Farmer	13441	59.0	31	13.5	12.1	71.6	.56	68	3.25	60	1	865	90	95	810	3.25	3.25
K338AA x Ns.3880.191	13319	61.5	26	14.1	12.8	72.0	.53	65	2.25	46	2	910	95	100	845	2.00	1.50
Lee x N.D. 34	13322	60.7	29	12.4	11.6	73.3	.46	62	2.50	40	2	758	80	90	785	3.75	1.25
Lee[6] x Ken. Farmer	13221	60.7	27	13.3	11.8	72.5	.52	66	2.50	43	2	840	100	90	795	3.00	2.00
								Dickinson, North Dakota									
Conley	13157	58.0	30	15.3	14.1	70.0	.40	60	2.00	67	2	903	100	100	910		
Lee	12488	60.2	30	16.0	14.6	65.0	.43	58	1.75	52	1	880	95	95	935		
Selkirk	13100	58.0	32	15.0	14.1	75.0	.44	61	2.50	67	2	873	95	95	910		
Thatcher	10003	60.2	32	14.9	13.9	71.0	.43	61	2.00	66	1	908	85	100	900		
Rushmore x Ken. Farmer	13207	60.6	33	15.6	14.3	72.0	.39	60	2.25	71	2	833	85	90	920		
Ns.4021 x Ken. Farmer	13441	58.6	33	16.4	15.3	66.0	.45	61	2.00	71	1	988	80	90	970		
K338AA x Ns.3880.191	13319	61.0	30	17.3	15.5	67.0	.48	62	1.50	55	1	928	85	100	980		

Table 1.--(Continued)

Variety or Cross	C.I. No.	Test weight	Pearling index value	Protein: Wheat	Protein: Flour	Flour: Yield	Flour: Ash	Absorption	Mixing time	Sedimentation value	Optimum baking method: Bromate	Optimum baking method: Loaf volume	Optimum baking method: Crumb Color	Optimum baking method: Crumb Grain	Expected loaf volume	Quality of dough according to mixogram tests: Development time	Quality of dough according to mixogram tests: Mixing tolerance
		Lbs.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Ml.	Mg.	Cc.	Score	Score	Cc.	Min.	Min.
								Edgeley, North Dakota									
Conley	13157	56.6	32	15.8	14.6	72.0	.40	61	2.25	69	2	893	85	95	935		
Lee	12488	57.6	31	16.4	15.4	68.0	.45	60	2.00	65	2	865	85	95	975		
Mida	12008	59.7	35	15.2	13.8	75.0	.40	58	2.00	67	2	860	95	95	895		
Rushmore	12273	58.0	32	15.9	14.5	71.0	.44	58	2.50	70	1	815	80	80	930		
Selkirk	13100	56.5	34	15.0	13.8	75.0	.41	58	2.50	70	1	865	85	90	895		
Thatcher	10003	58.0	30	15.6	14.2	71.0	.44	58	2.75	70	2	855	75	80	915		
Ns.4021 x Ken. Farmer	13441	57.6	35	16.5	15.5	68.0	.43	64	3.00	72	2	955	85	85	980		
K338AA x Ns.3880.191	13319	59.2	29	16.7	14.9	68.0	.44	62	2.25	68	2	933	90	95	950		
								Creston, Montana (Dryland)									
Lee	12488	61.3	31	13.0	12.4	71.0	.44	62	2.25	60	2	798	85	95	820		
Selkirk	13100	60.5	32	12.2	11.7	75.5	.41	63	2.00	45	2	808	90	95	790		
Conley	13157	61.2	28	12.8	12.1	73.5	.41	64	2.00	56	2	783	90	95	810		
Thatcher	10003	60.8	27	12.8	12.2	74.4	.49	64	2.00	55	2	770	80	95	815		

Strain H305-2(Henry x Supresa) has produced exceptionally good bread for having only a 10.4-percent protein content in the flour. The grain of the bread was exceptionally good. It milled satisfactorily and produced a high yield of flour. The dough characteristics were weak according to the mixograph curves and also in the make-up process.

Of the two sister strains, sample H441b-15-2-2-4 appears to be slightly stronger in general quality properties than H441b-15-2-2-3. Both have milled satisfactorily, produced a good yield of flour, and made bread of excellent grain. The only possibly questionable property of these two strains is their medium-high flour ash content. Both are higher in this respect than the comparably grown and approved hard red spring varieties. They do not appear to be so strong in dough quality as some of the approved hard red spring wheats.

Minnesota - Samples were received from two Minnesota stations, Crookston and Morris. The wheats from Crookston were considerably lower in protein content than the wheats from Morris, Minnesota, which accounts to a large extent for the higher bread loaf volumes from the latter station. The approved hard red spring varieties made generally satisfactory bread and were similar in quality to past years' results.

Russell was one of the wheats lower in protein content from the two stations. It produced a relatively high yield of flour considering the test weight per bushel of the grain. The dough-mixing pattern determined by the mixograph showed that it was better than Lee at one station and the same as Lee at the other station in dough mixing and tolerance properties.

Strain Rushmore x Kenya Farmer (ND 16) appears to be the best of the crosses in general quality for bread. It had excellent milling properties and was one of the better wheats in mixing time and tolerance from the Minnesota stations.

Strain Ns.4021 x Kenya Farmer (ND 25) has made good bread and, according to the mixograph tests, has a long mixing time and good mixing tolerance. The ash content of the flour from the Morris, Minnesota, sample was higher than that from the approved varieties.

Strain K338AA x Ns.3880.191 (ND 58) was of good quality for bread but was not so strong in mixing time or tolerance as Lee. The Morris, Minnesota, sample was high in flour ash content.

The dough properties of Lee^6 x Kenya Farmer (CT 231) were strong and generally similar to Lee, according to the mixograph tests. The loaf volume of the bread was about that expected for the protein content of the flour. The internal characteristics of the bread (grain and color) were very good.

North Dakota - North Dakota samples were received from Langdon, Minot, Williston, Fargo, Dickinson, and Edgeley. The quality results have been discussed on the basis of the data as a whole. The only exception to this is where a variety or strain has shown a particular quality property that should be specifically pointed out.

Most samples made reasonably good bread with little difference in quality between some varieties and strains. The protein content was generally highest in the Williston, North Dakota, samples followed by the Dickinson, Edgeley, and Minot samples with the Fargo wheats lowest of the six stations. No doubt this higher protein content accounts, in part, for the generally better loaf volumes obtained on the Williston and Minot samples.

The Fargo and Dickinson samples made bread that was particularly good in the grain of the crumb, and with the exception of one cross at each station all scored high in color.

The named varieties generally made satisfactory bread, with some better than others. Conley, Thatcher, and Selkirk appear to be the strongest of the wheats in general properties, but the differences between these and the other varieties were not great. At three of the stations Lee made good bread but was lower in loaf volume than expected for the protein content of the flour. Chinook, from Williston, North Dakota, made about average bread in grain and crumb color; and the loaf volume was about that expected when considered in relation to the protein content of the sample. Rescue, from Williston, North Dakota, had the highest loaf volume of the wheats from the six stations. Rescue scored only medium in internal bread characteristics and was poorest of the varieties in crumb grain. All the varieties milled satisfactorily. Conley and Selkirk appear to be the best of the wheats in yield of flour. Both have produced generally more flour than the other comparably grown varieties from these stations and also when considered in relation to the test weight per bushel of the grain.

Strain Rushmore x Kenya Farmer (ND 16, C.I. 13207) was perhaps best of the strains in milling quality. It was rated very good to excellent in milling properties and produced a high yield of flour. At Langdon and Minot the flour yield was 76.2 and 76.3 percent, respectively. The ash content of the flour was low. The dough-handling properties were strong in the punching and panning operations. The strong dough properties of this strain are also shown by the mixogram tests. These tests showed it was one of the best samples in mixing time and mixing tolerance. It appears to be a satisfactory bread wheat and has many of the properties found in the approved varieties.

Strain Ns.4021 x Kenya (ND 25, C.I.13441) produced about a medium yield of flour in accordance with the test weight per bushel of the grain. It was deficient in milling properties at the Williston, Dickinson, and Fargo stations, but satisfactory at the other stations. It averaged somewhat higher in ash content of flour than comparably grown samples of Lee. The dough-handling properties of ND 25 were medium strong and, according to the mixogram tests, had a medium-to-long mixing time and mixing tolerance. The bread characteristics were good. The grain and the crumb color have been particularly satisfactory. At three of the stations the loaf volumes were high varying from 1015 cc. to 1095 cc. This is a somewhat higher loaf volume than expected when considered in relation to the protein content of the flour.

Strain K338AA x Ns3880.191 (ND 58, C.I. 13319) produced about the yield of flour expected according to the test weight per bushel of the grain. It was deficient in milling characteristics at Dickinson and Fargo but satisfactory at Minot, Edgeley, and Langdon, North Dakota. The dough-handling properties are only medium strong. The dough-mixing time was medium and the mixing tolerance short according to the mixogram tests. The flour ash content of the Fargo, Dickinson, and Langdon samples averaged higher than comparably grown samples of Lee; while at the Minot station both were about the same. Strain ND 58 has produced good bread and the loaf volume was about that expected for the protein content of the flour. One favorable property of this strain was the satisfactory internal characteristics of the bread. The Fargo sample produced bread having exceptionally good crumb color and grain characteristics. In the mixogram tests ND 58 has shown a shorter mixing time and mixing tolerance than Conley.

Strain Lee x ND 34(ND 81, C.I. 13322), grown only at Fargo, North Dakota, had good milling characteristics and produced a relatively good yield of flour. It appears on the basis of this one test that ND 81 is about similar to the Fargo-grown Lee for most of the characteristics for which comparisons have been made. One exception to this is in the internal bread properties for ND 81, which are only slightly lower than those of Lee.

Comparable milling and baking tests of 2 samples of Lee^6 x Kenya Farmer (R.L. 2937) grown at Minot and Fargo, North Dakota, show that this strain has good milling characteristics. It is very similar to comparably grown samples of Lee for most of the characteristics for which comparisons have been made. One exception to this is that the ash content of the flour averaged slightly higher than that of the flour from the comparably grown samples of Lee. The dough-handling properties of this strain were similar to those of Lee in the punching and panning operations. Average figures from mixogram tests show that both were similar in mixing time and mixing tolerance.

Montana - Montana samples were received only from Creston (dryland). The best bread from the varieties in plots was made from Selkirk, followed by Conley, Lee, and Thatcher. Selkirk was highest in yield of flour and had excellent milling properties. Conley and Thatcher were stronger in dough-handling properties than the other two varieties. All four varieties made satisfactory bread.

Uniform Regional Nursery Composite

Twenty-four wheats from the uniform regional nursery have been tested in duplicate for their milling, baking, and chemical properties. These consisted of an eastern composite of grain from 8 stations and a western composite of grain from 5 stations.

The results of the quality tests for the eastern and western composites and the averages of both are shown in table 2. The discussion of these samples will be based principally on the averages, except possibly for some reference for the purposes of comparison to the results obtained on the same varieties and strains grown at either the eastern or western composite stations.

Table 2.--Milling, baking, and chemical results on 24 wheats grown in the Uniform Regional Nursery for the Eastern Composite, Western Composite, and the averages of the Eastern and Western Composites in 1957.

Variety or Cross	C.I. No.	Test weight	Pearling index value	Protein		Flour		Absorption	Mixing time	Sedimentation value	Optimum baking method				Expected loaf volume
				Wheat	Flour	Yield	Ash				Bromate	Loaf volume	Crumb Color	Crumb Grain	
		Lbs.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Ml.	Mg.	Cc.	Score	Score	Cc.
							Eastern Composite 1/								
Marquis	3641	55.5	24	14.5	13.4	72.0	.49	60	2.00	62	2	833	75	85	875
Thatcher	10003	55.1	24	14.7	13.6	73.0	.49	59	2.00	63	1	843	75	95	885
Selkirk	13100	55.7	30	15.4	14.5	75.0	.49	62	2.25	67	1	915	85	100	930
Lee	12488	57.5	28	15.4	14.4	72.0	.48	61	2.00	66	2	830	85	95	925
Reward x C.I. 12632	13406	59.0	29	15.2	14.2	74.0	.50	60	2.25	67	2	815	75	85	915
"	13407	59.0	28	15.6	14.2	74.0	.51	60	2.50	68	2	813	75	90	915
Conley	13157	54.6	28	15.4	14.5	74.0	.48	61	2.75	70	2	860	80	95	930
N2350 x Th.-K338AC	13223	59.0	31	15.4	14.0	74.0	.42	60	2.75	68	2	915	80	90	905
K338AA x N2350	13224	57.0	32	15.6	14.2	75.0	.48	60	1.75	65	2	933	80	95	915
K338AA x Ns.3880.191	13301	59.4	24	14.8	13.8	73.0	.49	60	2.25	65	2	883	85	100	895
"	13302	59.8	26	15.4	14.3	75.0	.50	60	2.00	66	2	905	85	95	920
Thatcher x Ken. Farmer	13211	60.0	31	15.4	13.6	75.0	.43	60	1.75	65	2	920	75	90	885
N.D.4 x Ns.3880.227	13317	58.1	31	15.5	14.4	75.0	.43	60	2.50	69	2	973	85	95	925
K338AA x Ns.3880.191	13319	59.5	25	16.2	14.9	71.0	.50	62	2.00	62	2	958	85	95	950
Rushmore x Ken. Farmer	13320	57.1	28	14.6	13.4	76.0	.45	59	2.25	70	2	740	75	90	875
Lee x N.D.34	13322	58.1	28	15.2	13.8	73.0	.45	59	2.00	67	2	838	95	100	895
N.D.4 x Lee	13324	51.1	33	16.6	15.1	72.0	.50	63	2.00	69	2	870	90	95	960
II-44-29 x Lee	13325	56.6	34	14.3	13.1	71.0	.47	60	2.25	59	1	880	90	95	860
"	13401	55.5	36	14.4	13.3	73.0	.49	62	2.00	58	2	885	90	95	870
Thatcher x Ken. Farmer	13402	56.4	29	15.9	14.7	73.0	.49	60	3.00	71	2	935	85	100	940
"	13403	57.1	32	15.5	14.5	75.0	.49	59	2.50	71	2	845	85	100	930
II-44-11 x Lee[3]	13404	56.3	27	15.6	14.7	72.0	.51	63	2.50	72	2	790	80	100	940
Timstein x Henry	13405	55.8	31	15.3	14.1	72.0	.48	60	2.50	72	3	953	85	95	910
Thatcher x R.L. 2564	13332	56.1	26	15.4	14.7	70.0	.45	58	2.75	71	2	835	85	90	940

Table 2.--(Continued)

Variety or Cross	C.I. No.	Test weight	Pearling index value	Protein: Wheat	Protein: Flour	Flour: Yield	Flour: Ash	Absorption	Mixing time	Sedimentation value	Optimum baking method: Bromate	Optimum baking method: Loaf volume	Optimum baking method: Crumb: Color	Optimum baking method: Crumb: Grain	Expected loaf volume
		Lbs.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Ml.	Mg.	Cc.	Score	Score	Cc.
							Western Composite 2/								
Marquis	3641	58.6	26	16.0	15.1	71.0	.46	59	2.25	67	1	898	85	90	960
Thatcher	10003	57.5	28	16.5	15.4	71.0	.48	60	2.50	68	1	948	80	95	970
Selkirk	13100	56.3	30	15.5	14.4	74.0	.46	60	2.50	69	2	860	85	100	925
Lee	12488	57.8	31	16.2	15.2	71.0	.46	60	2.50	66	2	925	95	100	965
Reward x C.I. 12632	13406	59.6	28	16.4	15.2	70.0	.46	59	2.25	68	1	840	85	90	965
"	13407	59.4	30	16.6	15.3	71.0	.44	60	2.75	69	2	890	85	90	970
Conley	13157	57.2	33	16.4	15.3	72.0	.42	59	2.50	68	2	950	90	90	970
N2350 x Th.-K338AC	13223	58.6	31	16.4	15.0	72.0	.40	58	2.25	69	2	925	85	95	955
K338AA x N2350	13224	57.8	31	15.7	14.6	73.0	.43	59	2.00	68	2	910	90	95	935
K338AA x Ns.3880.191	13301	60.2	29	16.0	15.1	70.0	.44	59	2.25	66	2	930	90	100	960
"	13302	61.5	29	16.3	15.0	71.0	.47	61	2.25	69	2	933	90	95	955
Thatcher x Ken. Farmer	13211	59.7	32	16.6	14.9	71.0	.41	60	1.50	65	1	943	80	95	950
N.D.4 x Ns.3880.227	13317	58.2	35	16.5	15.2	72.0	.43	59	2.25	70	2	970	85	100	965
K338AA x Ns.3880.191	13319	60.1	30	16.6	15.6	69.0	.45	62	2.25	65	1	955	85	100	985
Rushmore x Ken. Farmer	13320	59.3	29	15.3	14.0	73.0	.37	60	2.50	71	2	783	75	85	905
Lee x N.D.34	13322	57.7	31	15.8	14.6	70.0	.41	59	2.50	67	2	948	95	95	935
N.D.4 x Lee	13324	57.2	34	16.5	15.3	70.0	.44	60	2.00	69	2	963	90	95	970
II-44-29 x Lee	13325	57.0	35	15.0	13.7	68.0	.40	61	2.00	66	2	920	90	90	890
"	13401	55.8	37	14.9	14.0	69.0	.42	60	2.25	66	2	913	90	95	905
Thatcher x Ken. Farmer	13402	57.2	32	16.6	15.5	71.0	.45	60	2.25	71	1	920	80	95	980
"	13403	57.2	34	16.6	15.5	72.0	.48	61	2.00	71	2	993	85	95	980
II-44-11 x Lee	13404	56.5	28	16.4	15.4	70.0	.49	60	2.00	70	2	788	80	85	975
Timstein x Henry	13405	56.5	34	15.5	14.8	73.0	.44	60	2.00	72	2	895	85	90	945
Thatcher x R.L.2564	13332	57.1	30	16.1	15.3	72.0	.45	60	2.25	72	2	843	75	85	970

Table 2.--(Continued)

Variety or Cross	C.I. No.	Test weight	Pearling index value	Protein: Wheat	Protein: Flour	Flour: Yield	Flour: Ash	Absorption	Mixing time	Sedimentation value	Optimum baking method: Bromate	Optimum baking method: Loaf volume	Optimum baking method: Crumb Color	Optimum baking method: Crumb Grain	Expected loaf volume	Quality of dough according to mixogram tests: Development time	Quality of dough according to mixogram tests: Mixing tolerance
		Lbs.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Ml.	Mg.	Cc.	Score	Score	Cc.	Min.	Min.
								Average of the Eastern and Western composites									
Marquis	3641	57.1	25	15.3	14.3	71.5	.48	60	2.13	65	2	866	80	88	918	3.75	2.50
Thatcher	10003	56.3	26	15.6	14.5	72.0	.49	60	2.25	66	1	896	78	95	928	4.00	2.75
Selkirk	13100	56.0	30	15.5	14.5	74.5	.48	61	2.38	68	2	888	85	100	928	3.75	2.50
Lee	12488	57.7	30	15.8	14.8	71.5	.47	61	2.25	66	2	878	90	98	945	3.25	2.25
Reward x C.I. 12632	13406	59.3	29	15.8	14.7	72.0	.48	60	2.25	68	2	828	80	88	940	4.75	2.25
"	13407	59.2	29	16.1	14.8	72.5	.48	60	2.63	69	2	852	80	90	942	4.75	2.75
Conley	13157	55.9	31	15.9	14.9	73.0	.45	60	2.63	69	2	905	85	93	950	3.50	2.00
N2350 x Th.-N338AC	13223	58.8	31	15.9	14.5	73.0	.41	59	2.50	69	2	920	83	93	930	3.50	2.75
N338AA x N2350	13224	57.4	32	15.7	14.4	74.0	.46	60	1.88	67	2	922	85	95	925	2.50	2.00
N338AA x Ns.3880.191	13301	59.8	27	15.4	14.5	71.5	.47	60	2.25	66	2	907	88	100	928	3.25	1.75
"	13302	60.7	28	15.9	14.7	73.0	.49	61	2.13	68	2	919	88	95	938	3.00	2.00
Thatcher x Ken. Farmer	13211	59.9	32	16.0	14.3	73.0	.42	60	1.63	65	2	927	78	93	918	2.25	1.00
N.D.4 x Ns.3880.227	13317	58.2	33	16.0	14.8	73.5	.43	60	2.38	70	2	972	85	98	945	3.25	2.50
N338AA x Ns.3880.191	13319	59.8	28	16.4	15.3	70.0	.48	62	2.13	64	2	957	85	98	968	2.50	1.25
Rushmore x Ken. Farmer	13320	58.2	29	15.0	13.7	74.5	.41	60	2.38	71	2	762	75	88	890	4.50	3.25
Lee x N.D.34	13322	57.9	30	15.5	14.2	71.5	.43	59	2.25	67	2	893	95	98	915	3.50	1.50
N.D.4 x Lee	13324	54.2	34	16.6	15.2	71.0	.47	62	2.00	69	2	917	90	95	965	2.75	2.00
II-44-29 x Lee	13325	56.8	35	14.7	13.4	69.5	.44	61	2.13	63	2	900	90	93	875	3.00	1.50
"	13401	55.7	37	14.7	13.7	71.0	.46	61	2.13	62	2	899	90	95	888	3.00	1.50
Thatcher x Ken. Farmer	13402	56.8	31	16.3	15.1	72.0	.47	60	2.63	71	2	928	83	98	960	4.00	3.25
"	13403	57.2	33	16.1	15.0	73.5	.49	60	2.25	71	2	919	85	98	955	2.75	1.25
II-44-11 x Lee[3]	13404	56.4	28	16.0	15.1	71.0	.50	62	2.25	71	2	797	80	93	958	5.75	3.50
Timstein x Henry	13405	56.2	33	15.4	14.5	72.5	.46	60	2.25	72	3	924	85	93	928	3.00	1.50
Thatcher x R.L.2564	13332	56.6	28	15.8	15.0	71.0	.45	59	2.50	72	2	839	80	88	955	5.50	3.00

Most of the samples from the uniform regional nurseries made reasonably good bread, with only slight difference in quality between many of the varieties and strains.

In some years the properties or characteristics of the same variety or strain grown at the eastern or western composite stations are somewhat different due, no doubt, to a difference in environmental conditions. The western composites were higher in test weight and protein content than the eastern nursery samples in 1957 but gave slightly lower flour yields with the exception of Timstein x Henry (C.I. 13405) and Thatcher x R.L. 2564 (C.I. 13332) which were 1.0 to 2.0 percent higher in the western composite samples. Water absorption varied within the narrow ranges of 58 to 62 percent for the western composites and 58 to 63 percent for the eastern samples. The dough-mixing times were medium to long for most varieties and strains from both nursery composites. However, the eastern composite of Thatcher x Kenya Farmer(C.I. 13402) had a tendency to be "bucky" and required a slightly longer mixing time. The flour ash content averaged slightly higher in the eastern samples with a range of 0.45 to 0.51 percent, with the exceptions of N2350 x That.-K338AC (C.I. 13223), That. x Kenya Farmer (C.I.13211), and ND 4 x Ns3880.227 (C.I.13317) which had 0.42, 0.43, and 0.43 percent respectively. The range for the western samples was 0.40 to 0.49 percent, except for Rushmore x Kenya Farmer (C.I.13320) with a 0.37 percent ash.

The loaf volumes were slightly higher and the crumb color and grain of the bread better for the western than for the eastern nursery samples, except for the western Thatcher x R.L. 2564 (C.I. 13332) which graded slightly lower in color than the eastern sample. In general, most of the flours tested gave loaf volumes a little below that expected for any given flour protein content of the same level. The optimum bromate requirements averaged about the same for all nursery composites.

The approved and named hard red spring varieties, Marquis, Thatcher, Selkirk, Lee, and Conley, made satisfactory bread. Thatcher and Conley were slightly stronger in quality and showed good dough strength. Selkirk produced a better yield of flour (1.0 to 3.0 percent higher) than the other 4 approved varieties, but yields were lower from the western samples than those from the eastern composites of the same variety.

Strain Thatcher x Kenya Farmer (C.I. 13402) appeared to be one of the best quality-wise in the eastern group of samples but did not prove to be outstanding in the western group.

The small differences in quality between a number of the strains have made it extremely difficult to rank the wheats. Most strains produced bread that was satisfactory in grain with some better than others. Many strains had good quality and many of the characteristics looked for in a wheat intended for bread. These wheats milled satisfactorily and produced a high yield of low-to-medium ash flour. The medium-low pearling index values indicate that these strains are similar to the approved hard red spring varieties in hardness. The strains ND 4 x Lee (C.I. 13322), II-44-29 x Lee (C.I. 13325), and II-44-29 x Lee (C.I. 13401) made good bread but had higher pearling index values, indicating a softer textured wheat which may cause them to be objectionable to the milling trade. These same 3 strains gave flour yields slightly below average. Strain II-44-11 x Lee[3] (C.I. 13404) had many favorable characteristics but a loaf volume that was low considering the protein content of the sample. The loaf volume for

strain Rushmore x Kenya Farmer (C.I. 13320) was lower than expected for the protein content of the sample. This sample had long development time and mixing tolerance, according to the mixogram tests.

Mixogram patterns or curves have been made on the flour composited by variety and strain from the 24 eastern and western samples. The results of these tests (table 2) show that there were some differences in the dough characteristics between a few of the samples. The mixogram patterns for the named varieties Marquis, Conley, Thatcher, Selkirk, and Lee were quite typical of good bread wheats and evidenced strong mixing properties.

There were a number of strains in addition to the named varieties that showed good dough stability or mixing tolerance. These are as follows: Reward x C.I. 12632 (C.I. Nos, 13406, and 13407), N2350 x Th-K338AC (C.I. 13223), ND 4 x Ns3880.227, Rushmore x Kenya Farmer (C.I. 13320), Thatcher x Kenya Farmer (C.I. 13402), II-44-11 x Lee^3 (C.I. 13404), and Thatcher x R. L. 2564(C.I. 13332). Thatcher x Kenya Farmer (C.I. 13211), K338AA x Ns3880.191 (C.I. 13319), and Thatcher x Kenya Farmer (C.I. 13403) had very short mixing tolerance times, showing an undesirable weakness in dough stability.

State Nursery Trials

Results for the samples grown in the State nursery trials are shown in table 3. These include samples from Madison, Wisconsin, and composites of a number of varieties and strains grown in the preliminary wheat II nursery at Watertown, Brookings, and Highmore, South Dakota. Similar tests were made on composites of a number of varieties and strains grown in the Sawfly nursery at Moccasin, Sidney, Froid, and Dutton, Montana, and from the advanced yield nursery at Sidney, Montana.

Madison, Wisconsin

The flour yield of these samples was remarkably good considering the relatively low test weight per bushel of most of the wheats.

Kenya produced a relatively high yield of flour for a wheat having a test weight of only 55.0 pounds. The dough-mixing time was satisfactory and the same as that of Lee. The dough-handling properties were slightly sticky, which is an objectionable property of the variety. The bread characteristics were good except for crumb color, which was medium low. This sample is classed as strong in dough properties according to the mixogram curve tests.

Veadeiro was deficient in yield of flour and milling characteristics, high in ash content of flour, low in crumb color of bread, and the dough-handling properties were slightly weak. The loaf volume of the bread appears to be lower than expected for the protein content of the flour. The dough-mixing time, according to the mixogram tests, was medium and the mixing tolerance shorter than most of the approved hard red spring varieties.

Table 3.--Milling, baking, and chemical results on hard red spring wheats grown in State nursery trials, 1957 crop.

Variety or Cross	C.I. No.	Test weight	Pearling index value	Protein: Wheat	Protein: Flour	Flour: Yield	Flour: Ash	Absorption	Mixing time	Sedimentation value	Optimum baking method: Bromate	Optimum baking method: Loaf volume	Optimum baking method: Crumb: Color	Optimum baking method: Crumb: Grain	Expected loaf volume	Quality of dough according to mixogram tests: Development time	Quality of dough according to mixogram tests: Mixing tolerance	Rank
		Lbs.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Ml.	Mg.	Cc.	Score	Score	Cc.	Min.	Min.	
Rod-row yield nursery -- Madison, Wisconsin																		
Lee	12488	55.8	26	16.1	14.6	72.7	.57	61	2.25	46	2	885	75	90	935	3.00	2.50	
Kenya P.I.	177167	55.0	31	15.8	14.4	72.7	.50	59	2.25	60	2	915	75	95	925	2.50	1.50	
Veadeiro P.I.	192475	57.0	28	15.9	14.9	69.7	.62	60	2.00	42	2	833	70	95	950	2.00	1.50	
H500-6-5-4-3 (C.I.12633 x Henry)		55.8	26	15.7	14.6	74.3	.55	61	2.50	63	3	890	75	100	935	3.25	2.50	
C.I.12633 x Henry^2 Sel.1-1		58.4	30	15.8	14.9	72.8	.47	60	2.00	67	2	888	85	95	950	2.50	1.75	
Henry	12265	56.0	27	13.2	12.6	76.9	.52	57	2.00	46	2	823	75	95	835	2.75	1.50	
H515b-6-1-2-1		55.6	26	15.6	14.8	71.2	.50	60	2.25	66	1	935	85	90	945	2.50	2.00	
H515b-7-2-12-2		55.7	28	15.8	15.0	72.8	.48	58	2.50	66	2	970	85	90	955	3.25	2.75	
H515b-7-2-12-2-5		55.2	27	15.8	14.8	72.5	.49	60	2.50	66	2	988	80	90	945	3.25	2.50	
South Dakota preliminary wheat II nursery 1/																		
P.W.36 x TT630	11817	58.8	40	16.0	14.1	71.4	.47	59	1.50	34	2	908	75	90	910	1.50	1.00	3
"	11818	59.4	35	15.8	14.5	71.3	.48	59	1.75	36	2	1010	90	90	930	2.50	1.75	2
"	11820	60.3	34	15.6	14.2	70.9	.44	59	1.50	29	2	845	80	85	915	1.75	1.00	3
"	11827	58.4	38	16.0	14.0	72.3	.47	59	1.25	27	2	865	75	85	905	1.25	.75	3
"	11835	58.4	40	15.3	14.1	75.1	.49	59	1.25	31	2	908	95	95	910	1.75	.75	3
"	11848	60.6	38	16.2	14.1	73.0	.46	58	1.00	26	2	850	75	85	910	1.50	.75	3
"	11849	59.4	41	15.1	13.9	75.3	.48	59	1.25	32	2	905	90	95	900	2.00	1.00	3
"	11850	59.7	36	15.7	14.3	74.5	.53	59	1.25	29	2	910	85	90	920	1.25	1.00	3
"	11855	59.7	37	14.8	13.2	76.3	.46	59	1.25	28	2	853	75	85	865	1.75	1.00	3
P.W.36 x 13039	11864	58.0	31	16.0	14.5	71.1	.55	59	1.25	34	2	873	75	90	930	1.75	1.50	3
Lee (check)	12488	57.2	30	16.2	15.3	74.5	.49	64	2.75	47	2	975	90	95	970	3.50	2.50	1

Table 3. (Continued)

Variety or Cross	C.I. No.	Test weight	Pearling index value	Protein: Wheat	Protein: Flour	Flour: Yield	Flour: Ash	Absorption	Mixing time	Sedimentation value	Optimum baking method: Bromate	Optimum baking method: Loaf volume	Optimum baking method: Crumb Color	Optimum baking method: Crumb Grain	Expected loaf volume	Quality of dough according to mixogram tests: Development time	Quality of dough according to mixogram tests: Mixing tolerance	Rank
		Lbs.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Ml.	Mg.	Cc.	Score	Score	Cc.	Min.	Min.	
South Dakota preliminary wheat II nursery 1/(Continued)																		
Minn. 2854 x Selkirk	11877	53.8	30	16.3	15.5	75.8	.50	66	2.50	63	2	975	80	85	980	3.50	2.50	1
"	11880	53.5	29	15.8	15.5	74.2	.52	63	2.00	46	2	950	85	100	980	2.00	1.50	2
Selkirk x 13039	11915	58.0	26	16.0	15.1	73.2	.53	64	2.50	42	2	980	85	90	960	4.00	3.00	1
Selkirk x W250	11955	57.1	31	16.3	15.0	69.9	.49	63	3.00	54	2	930	85	95	955	4.00	2.25	2
"	11960	57.0	30	15.9	14.8	72.9	.48	63	2.25	58	2	935	80	90	945	2.50	1.50	2
"	11973	56.3	29	16.0	15.3	72.9	.51	64	2.00	59	2	935	80	90	970	2.50	1.50	2
TT630 x 13039	11985	58.8	41	15.2	13.7	71.2	.40	60	1.50	35	2	933	90	95	890	2.00	1.00	3
"	11986	59.5	38	15.9	13.6	72.4	.42	60	1.25	28	2	915	90	85	885	1.75	1.25	3
Selkirk x Triunfo	12007	58.4	37	15.1	14.2	73.8	.46	61	1.75	44	2	1010	95	90	915	1.75	1.50	3
Selkirk (Check)	13100	55.0	36	15.8	15.3	75.0	.48	64	2.25	60	2	1035	85	85	970	3.00	2.50	1
RH 1935-170	12160	59.0	29	16.2	15.4	72.1	.45	64	1.50	65	2	993	85	90	975	2.00	1.50	2
" -193	12138	59.5	30	16.3	15.3	73.0	.44	64	1.50	62	2	980	95	95	970	1.75	1.25	3
" -147	12150	60.1	29	15.9	14.8	72.2	.43	62	1.25	62	2	918	90	95	945	1.75	1.00	3
" - 96	12156	60.2	30	16.0	14.7	72.3	.46	62	1.25	63	2	908	95	95	940	2.00	1.00	3
" -200	12155	59.5	28	15.7	14.6	72.7	.44	61	1.50	60	2	923	95	100	935	2.00	1.25	3
" -191	12128	59.7	29	16.1	14.9	73.0	.43	61	1.50	63	2	953	90	90	950	1.75	1.00	3
" - 7	12133	60.0	29	15.9	14.9	70.3	.46	61	1.50	63	2	945	90	95	950	1.75	1.50	2
" - 82	12147	59.4	30	15.6	14.9	73.4	.44	60	1.25	60	2	940	95	95	950	1.50	1.00	3
RH 1935 (Check)		59.2	29	15.7	14.8	73.4	.47	61	1.25	63	2	933	95	95	945	1.75	1.50	2
RH 1935-10	12131	59.2	30	15.9	14.9	73.1	.45	63	1.50	63	2	975	90	90	950	1.75	1.25	3
" -98	12148	60.0	29	15.7	14.6	73.9	.44	63	1.25	61	2	908	80	100	935	1.75	1.00	3
" -61	12144	59.8	29	16.1	15.1	71.4	.46	64	1.25	65	2	923	85	100	960	1.50	1.25	3
" -62	12141	60.0	30	15.9	14.9	72.3	.44	62	1.25	60	2	900	85	100	950	1.75	1.25	3
Rushmore[3] x Surpresa-863		58.2	28	14.8	13.8	74.8	.49	60	2.25	46	2	908	85	90	895	3.25	4.00	1

Table 3. (Continued)

Variety or Cross	C.I. No.	Test weight	Pearling index value	Protein: Wheat	Protein: Flour	Flour: Yield	Flour: Ash	Absorption	Mixing time	Sedimentation value	Optimum baking method: Bromate	Optimum baking method: Loaf volume	Optimum baking method: Crumb Color	Optimum baking method: Crumb Grain	Expected loaf volume	Quality of dough according to mixogram tests: Development time	Quality of dough according to mixogram tests: Mixing tolerance	Rank
		Lbs.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Ml.	Mg.	Cc.	Score	Score	Cc.	Min.	Min.	
South Dakota preliminary wheat II nursery 1/ (Continued)																		
Rushmore[3] x Surpresa-710		60.5	31	15.5	14.3	73.8	.46	60	2.50	45	2	973	90	90	920	3.00	2.25	1
" -648		60.7	25	15.3	14.2	74.6	.49	60	2.75	61	2	843	90	100	915	5.25	4.75	1
" -992		60.8	30	15.6	14.4	73.2	.47	60	1.25	33	2	900	90	95	925	1.50	1.00	3
" -739		60.1	29	15.4	14.0	71.6	.47	60	1.25	34	2	893	90	90	905	2.00	1.25	3
" -975		60.5	28	15.3	13.8	72.2	.44	62	1.50	37	1	930	90	95	895	2.50	1.00	2
" -851		58.8	29	14.8	13.8	70.0	.48	60	2.00	37	2	923	90	90	895	2.75	1.75	2
" -997		59.7	32	15.4	14.2	75.2	.46	60	1.25	33	2	915	85	100	915	1.75	1.00	3
" -986		59.8	29	15.2	14.0	71.9	.51	60	1.75	34	1	855	85	100	905	2.50	1.50	2
" -905		60.2	27	15.3	14.2	71.3	.49	61	2.00	36	2	935	95	100	915	3.50	2.25	1
Rushmore x Java 1440		59.7	29	15.7	14.7	72.8	.51	61	1.25	31	2	903	85	95	940	1.75	.75	3
Montana Sawfly Nursery 2/																		
Rescue x Chinook	13310	60.8	33	17.5	16.2	69.5	.49	63	2.25	73	2	955	80	85	1015			
"	13329	60.5	35	16.8	15.8	74.2	.43	62	2.25	72	1	973	85	80	995			
Rescue x 1831	13311	60.8	27	15.9	14.5	74.6	.49	63	2.75	72	1	820	70	85	930			
Rescue x Chinook	13330	60.5	36	16.8	16.0	73.2	.47	63	2.25	74	2	978	85	85	1005			
Thatcher	10003	58.1	29	16.9	15.8	71.9	.50	64	2.25	71	2	980	75	90	995			
Rescue x Chinook	13309	60.1	28	16.4	15.7	72.6	.50	63	2.75	73	2	925	75	95	990			
Rescue x Thatcher	13307	61.5	33	16.9	15.9	74.1	.48	63	2.50	74	2	1008	75	95	1000			
Rescue	12435	59.7	33	16.5	15.7	72.9	.50	62	2.50	74	1	1020	75	85	990			
Rescue x Cadet	13328	60.1	26	17.3	16.0	70.4	.53	65	2.75	73	2	953	90	95	1005			
Rescue x Chinook	13309	60.6	30	16.1	15.5	73.5	.50	67	3.00	71	1	950	90	95	980			
Thatcher[4] x Rescue	B57-204	60.6	26	16.7	16.1	69.6	.58	68	3.25	66	2	948	75	90	1010			
"	B57-202	60.8	27	16.6	16.3	71.8	.57	69	3.25	67	2	945	70	85	1020			
Rescue x Cadet	13326	60.7	31	16.1	15.9	74.7	.52	67	2.75	69	2	935	85	85	1000			
C.T. 609 x Rescue	13331	62.2	31	16.9	16.1	73.6	.49	67	2.50	70	2	1050	90	80	1010			
Rescue x Chinook	13327	60.2	33	16.2	15.6	73.5	.45	66	3.00	74	2	935	80	90	985			
Rescue x 1831	13304	60.8	31	16.4	15.7	74.5	.49	67	3.00	70	1	960	85	90	990			
Thatcher[4] x Rescue	B57-205	60.1	25	16.8	16.1	73.1	.60	69	3.00	66	1	885	85	95	1010			

Table 3. (Continued)

Variety or Cross	C.I. No.	Test weight	Pearling index value	Protein: Wheat	Protein: Flour	Flour: Yield	Flour: Ash	Absorption	Mixing time	Sedimentation value	Optimum baking method: Bromate	Optimum baking method: Loaf volume	Optimum baking method: Crumb: Color	Optimum baking method: Crumb: Grain	Expected loaf volume
		Lbs.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Ml.	Mg.	Cc.	Score	Score	Cc.
						Sidney, Montana Advance Yield Nursery									
		61.1	32	16.0	15.0	75.3	.47	67	2.50	67	2	950	95	90	955
Thatcher	10003	61.2	32	15.7	15.0	71.0	.43	69	2.25	68	1	928	80	90	955
1953 x Lee		61.7	38	14.9	13.8	75.7	.38	68	2.25	68	2	905	85	90	895
Pilot[2] x Regent	13042	61.7	35	14.9	13.8	76.6	.42	62	2.00	70	2	933	85	90	895
Lee[6] x K. Farmer	13221	60.3	36	16.1	14.8	69.1	.39	67	1.75	60	2	880	95	90	945
Thatcher x Lee		59.8	38	15.5	14.7	76.9	.48	64	2.00	68	2	950	85	90	940
Rescue	12435	61.3	37	14.9	14.0	76.8	.46	63	2.00	70	2	960	75	90	905
Conley	13157	60.7	34	15.6	14.3	74.4	.40	66	1.75	71	2	953	95	95	920
Thatcher x Lee		61.5	38	15.5	14.4	75.2	.41	63	2.25	71	2	925	90	95	925
Russell	12484	60.5	34	14.7	13.6	73.9	.39	62	2.25	71	2	858	95	95	885
Rescue x 1831	13304	61.8	33	14.9	14.2	73.8	.43	62	2.25	70	2	848	85	95	915
Ceres, 6900	6900	62.0	28	15.1	14.2	74.8	.42	63	2.50	70	1	878	85	95	915
Thatcher x Lee		59.6	33	15.5	14.1	71.4	.47	63	1.50	52	2	838	80	100	910
Chinook	13220	62.1	34	15.3	14.7	74.3	.44	65	2.00	64	2	848	80	100	940
Centana	12974	61.5	30	14.8	13.8	71.5	.41	64	2.25	64	1	893	90	95	895
Thatcher x Lee		60.7	35	16.7	15.4	70.0	.46	64	1.75	59	2	920	85	90	970
Pilot	11945	60.5	30	15.1	14.0	70.9	.42	63	1.75	66	1	910	80	90	905
Thatcher x Lee		61.1	38	15.6	14.7	74.1	.36	62	2.00	71	2	965	90	95	940
Selkirk	13100	60.1	35	14.6	13.5	76.4	.40	63	2.25	67	2	870	95	100	880
1953 x Lee	13242	61.1	36	14.7	13.3	75.3	.36	63	2.00	66	2	918	95	90	870
Lee	12488	60.6	36	16.2	14.4	71.8	.41	64	1.75	62	2	925	95	90	920
1953 x Lee		63.0	34	16.1	12.3	71.6	.37	63	2.00	66	2	920	95	95	820
1953 x Lee		62.0	39	14.7	14.4	75.8	.36	64	2.25	68	1	923	95	95	920

1/ Composite of seed from Watertown, Brookings, and Highmore, South Dakota.
2/ Composite of seed from Moccasin, Sidney, Froid, and Dutton, Montana.

Strains H515b-6-1-2-1, 7-2-12-2, and 7-2-12-2-5 were very similar in quality and, considering the data as a whole, have shown strong bread characteristics. These are perhaps the best of the wheats among the rod-row samples. The yield of flour was high for these strains considering the medium-low test weight of the wheats, and the milling properties were good. The dough-mixing time and handling properties were satisfactory and bread properties very good. The mixogram curves show that the first of these strains (6-1-2-1) does not have quite as strong dough properties as the other two samples. The other wheat nearly equal to these three in quality is strain H500-6-5-4-3, which was higher in yield of flour and produced excellent grain in the bread.

Strain C.I. 12633 x Henry[2] Sel. 1-1 has also made good bread. The ash content of the flour was low, milling properties good, and yield of flour about that expected according to the test weight per bushel of the sample. The dough development and tolerance properties appear to be satisfactory but not so strong as those found in the Lee variety.

Watertown, Brookings, and Highmore, South Dakota

Preliminary Wheat II Nursery

The loaf volumes of the samples with few exceptions are about that expected for the protein content of the flour. In fact, most of the wheats have made good bread. A number of the strains were deficient in dough quality (mixing time, etc.), the principal reason for their lower numerical ranking. The wheats were relatively high in protein, with a number of them testing higher than 16.0-percent protein. The quality results have been discussed to a large extent based on a consideration of the data as a whole. The only exception to this is where a variety or strain has shown a particular quality property that should be specifically pointed out.

The strains of good quality (ranked first) and having many of the characteristics looked for in a wheat intended for bread were: Minn. 2854 x Selkirk (C.I. 11877); Selkirk x 13039 (C.I. 11915); Rushmore[3] x Surpresa (Nos. 863, 710, 648, and 905); Lee (C.I. 12488); and Selkirk (C.I. 13100). These wheats milled satisfactorily and produced a high yield of low-to-medium ash flour. The medium-low pearling index values indicate that these strains are similar to the approved hard red spring varieties in hardness. The dough properties were strong and inclined to be bucky with the higher amounts of the oxidization agent, potassium bromate. The loaf volumes of the bread were high and the grain of the crumb good. These wheats appear to show promise for bread, according to this year's test. The most encouraging characteristic of these strains is their strong dough properties. Rushmore[3] x Surpresa (No. 648) is perhaps strongest and best in overall quality (milling, bread, dough properties, etc.) of these wheats. Selkirk x W250 (C.I. 11955) is a good quality, strong wheat but was ranked down because the bran was difficult to clean free from flour. It is equal in all other characteristics to the wheats ranked as best.

Those wheats that were next best in quality (ranked second) were: P.W. 36 x TT630 (C.I. 11818); Minn. 2854 x Selkirk (C.I. 11880); Selkirk x W250 (C.I. 11960 and C.I. 11973); RH1935-170 (C.I. 12160); RH 1935 (check); RH 1935-7 (C.I. 12133); and Rushmore[3] x Surpresa (Nos. 975, 851, and 986). In most cases these strains made bread equal in quality to the strains ranked first, but the dough properties according to the mixogram tests were not so strong as Lee or Selkirk, included as standards of comparisons. The dough-handling properties of most of these strains were mellow, medium, elastic, and pliable. Only two of the wheats, P.W.36 x TT630 (C.I. 11818) and Rushmore[3] x Surpresa (986), produced slightly weak and sticky dough properties. The sticky property in a dough is considered objectionable, especially in machine-operated bakeries. Strain Rushmore[3] x Surpresa (861) was the only wheat among these to have questionable milling properties. The bran was tough, making it difficult to remove or separate the flour. All the other wheats milled satisfactorily, and many of them produced a relatively high yield of flour when considered in relation to the test weight per bushel of the grain. These wheats show promise and may be suitable for bread, although some are not so strong in certain quality properties as the approved and accepted hard red spring varieties. It is possible that in another year some of these wheats may show improved dough-handling properties.

The rest of the wheats in this nursery which have been ranked third have made relatively good bread, but their dough development time and mixing tolerance are somewhat less than those of the approved varieties Lee and Selkirk. These undesirable properties of the dough have made them questionable as meeting the exacting requirements of the baking industry. A number of these strains, however, that have some promising properties are: P.W. 36 x TT630 (C.I. 11835, 50, and 55), which had a high yield of flour for the test weight per bushel of grain; and (C.I. 11820), which was low in flour ash content. P.W. 36 x TT630 (C.I. 11849) and TT630 x 13039 (C.I. 11985) have made excellent bread with high loaf volume and good crumb color and grain. Selkirk x Triunfo (C.I. 12007) was high in loaf volume for the protein content of the flour and also had good internal bread characteristics. It also was high in flour yield for the test weight per bushel of grain. Many of the RH 1935 strains have produced bread of excellent crumb color and grain, and the flour has a low ash content.

Moccasin, Sidney, Froid, and Dutton, Montana

Sawfly Yield Nursery

The varieties and strains for this Montana composite have been ranked to a considerable extent based on a consideration of the quality data as a whole. Actually none of these samples have appeared to make bread that would be considered unsatisfactory. All the wheats were relatively high in protein content, with none lower than 14.5 percent in the flour.

Most of the wheats milled satisfactorily and were relatively high in test weight per bushel. The three samples that had questionable milling properties were Thatcher[4] x Rescue (B57-202, 204, and 205).

The yield of flour for a number of the wheats was high, considering their test weight per bushel, and averaged better than 74.0 percent.

The samples that made the best bread were Rescue x Chinook (C.I. 13308 and 13309) and Rescue x Thatcher (C.I. 13307). The yield of flour of these strains was high, dough-handling properties strong, and crumb grain of the bread excellent. The strain Rescue x Chinook (C.I. 13309) was strongest of the 3 wheats and the best in the sawfly nursery.

Those wheats that appear to be least desirable for bread because of one or more questionable properties are Rescue x 1831 (C.I. 13311), because of low loaf volume and crumb color of bread; and the three Thatcher^4 x Rescue strains because of deficient milling characteristics. The loaf volume of the bread for Thatcher^4 x Rescue (B57-205) was also lower than expected for the protein content of the flour.

The difference in quality between the rest of the samples which are rated as second best for bread is relatively small. All appear to be strong wheats and are high in protein content. These wheats, like the others in this nursery, had good dough-handling properties and were rated as strong to very strong in this respect. Some of these wheats have some very promising properties, for example: Rescue x Chinook (C.I. 13327) and Rescue x 1831 (C.I. 13304), which had long mixing times suggestive of a good mixing tolerance; C.T. 609 x Rescue (C.I. 13331) and Rescue, which produced bread high in loaf volume; and Rescue x Cadet (C.I. 13328), which had excellent crumb color and grain of bread.

Sidney, Montana, Advanced Yield Nursery

The small differences in quality between a number of the samples have made it extremely difficult to rank the wheats. Most all have produced bread satisfactory in grain, with some better than others. It is of interest that 11 of the 23 samples have produced bread scoring 95 or above in crumb grain. This excellent showing in one of the important bread properties should be encouraging proof of some of the satisfactory parent material being used in the hard red spring breeding program. The crumb color scores were also good, with 12 wheats making bread having crumb color scores of 90 or higher.

All the samples milled satisfactorily. Ten of the 23 varieties and strains had excellent milling properties. These promising milling wheats are 1953 x Lee (B52-92, C.I. 13242 and B52-94), Pilot^2 x Regent (C.I. 13042), Thatcher x Lee (B55-8, 4, 5), Rescue, Ceres, and Selkirk. A number of these wheats produced a high yield of flour, averaging 74.0 percent or better.

Those wheats perhaps strongest in quality and making the best bread, considering the data as a whole, were 1898 x Lee (B52-57), Lee^6 x K.F. (C.I. 13221), Thatcher x Lee (B55-4, and 5), 1953 x Lee (C.I. 13242, B52-90, and 94), Conley, Russell, Centana, Selkirk, and Lee. The dough-handling properties of most of these were strong, with some wheats producing bucky doughs when higher amounts of bromate were used in the formula. Thatcher x Lee (B55-2) and the Chinook variety have produced bread having excellent

grain but only medium in crumb color. Three other promising strains were medium in crumb color but have produced a high yield of flour and have strong dough properties. These are Pilot^2 x Regent (C.I. 13042), Thatcher x Lee (B55-8), and Rescue x 1831 (C.I. 13304). Thatcher x Lee (B55-2) had the shortest dough-mixing time of the wheats but was one of the best in grain of the bread.

Commercial Samples

As in past years, a number of commercially-grown wheat samples were obtained through the Grain Division, Agricultural Marketing Service, for comparison with the varieties and strains produced in experimental plots. Twenty-nine such samples representing a number of grades and subclasses were obtained at Great Falls, Montana, Denver, Colorado; and Minneapolis and Duluth, Minnesota. The samples were composited by grade from 4101 cars of wheat grading No. 4 or better. This is the nineteenth season such samples have been tested. The results are given in table 4.

These samples generally averaged lower in protein content than the varieties and strains grown in experimental plot and nursery trials. The Minneapolis and Duluth, Minnesota, samples averaged 14.0 percent protein; while the Great Falls, Montana, and Denver, Colorado, samples were somewhat higher, averaging 15.2 and 14.3 percent, respectively. The milling characteristics were much alike for the commercial and experimental samples, with the commercial samples possibly slightly higher in yield of flour. Otherwise, the baking and chemical results do not appear to be greatly different when compared with samples having approximately the same protein content.

Table 4.--Milling, baking, and chemical results on 29 composite commercial samples from 4,101 cars of hard red spring wheat obtained at Denver, Duluth, Great Falls, and Minneapolis, representing the 1957 crop.

Location Where Obtained	U. S. Grade	No. of Cars	Test weight	Pearling index value	Protein: Wheat	Protein: Flour	Flour: Yield	Flour: Ash	Absorption	Mixing time	Sedimentation value	Optimum Baking Method: Bromate	Optimum Baking Method: Loaf volume	Optimum Baking Method: Crumb: Color	Optimum Baking Method: Crumb: Grain	Expected loaf volume
			Lbs.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Ml.	Mg.	Cc.	Score	Score	Cc.
Denver, Colorado																
Do.	1HDNS	15	61.0	32	13.6	13.6	74.0	.45	60	2.25	44	1	783	95	85	885
Do.	1DNS	28	59.2	31	14.0	13.3	76.0	.42	59	2.25	59	2	800	85	90	870
Do.	2DNS	17	51.8	32	14.6	13.9	75.0	.44	59	2.25	64	1	843	80	95	900
Do.	3DNS	13	56.5	32	15.1	14.2	74.0	.44	60	2.75	64	1	850	75	90	915
Average			57.1	32	14.3	13.8	74.8	.44	60	2.38	58	1	819	84	90	892
			Lbs.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Ml.	Mg.	Cc.	Score	Score	Cc.
Duluth, Minn.																
Do.	1HDNS	40	60.0	30	13.8	12.3	75.0	.45	60	2.25	44	1	843	80	95	820
Do.	1DNS	311	59.0	30	14.4	13.4	74.2	.46	60	2.50	60	2	900	85	95	875
Do.	2DNS	287	58.4	32	14.2	13.5	75.0	.48	60	2.25	62	2	895	85	90	880
Do.	1NS	25	58.8	32	13.2	12.5	74.6	.44	62	2.50	55	2	870	95	90	830
Do.	2NS	76	57.7	32	13.5	12.5	74.5	.44	62	2.50	56	2	873	90	90	830
Do.	3NS	203	56.2	32	13.8	12.5	74.6	.48	62	2.50	53	2	905	90	90	830
Do.	4NS	115	54.8	32	14.1	12.8	75.0	.46	61	2.25	64	2	928	90	90	845
Do. 1/	2DNS	170	57.1	31	14.4	13.6	74.0	.47	58	2.25	66	2	878	95	95	885
Do.	3DNS	52	56.6	32	14.4	13.5	73.9	.50	62	2.50	64	2	923	90	100	880
Do.	4NS	54	55.0	33	14.2	12.9	73.9	.45	61	2.50	64	2	935	90	85	850
Average			57.4	32	14.0	13.0	74.5	.46	61	2.40	59	2	895	89	92	852

Table 4. (Continued)

Location Where Obtained	U. S. Grade	No. of Cars	Test weight	Pearling index value	Protein: Wheat	Protein: Flour	Flour: Yield	Flour: Ash	Absorption	Mixing time	Sedimentation value	Optimum Baking Method: Bromate	Optimum Baking Method: Loaf volume	Optimum Baking Method: Crumb: Color	Optimum Baking Method: Crumb: Grain	Expected loaf volume
			Lbs.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Ml.	Mg.	Cc.	Score	Score	Cc.
Great Falls, Mont.																
Do.	1HDNS	322	61.2	28	14.1	13.2	73.6	.45	63	2.50	64	1	895	80	85	865
Do.	1DNS	584	59.0	27	15.4	14.6	72.6	.48	63	2.50	69	2	1028	80	85	935
Do. 2/	2DNS	22	59.8	28	14.3	13.3	73.7	.49	64	2.75	65	1	920	80	90	870
Do. 3/	2DNS	283	57.7	28	16.1	15.1	72.2	.50	63	2.25	69	2	960	85	95	960
Do.	3DNS	87	56.7	28	16.8	15.7	72.0	.51	64	2.50	69	2	980	80	80	990
Do. 4/	2DNS	28	59.9	28	14.6	14.3	73.2	.47	64	2.50	69	1	933	90	95	920
Do. 5/	3DNS	84	59.8	26	15.1	14.3	73.5	.48	65	2.50	68	2	925	90	95	920
Do. 6/	3DNS	38	58.3	27	15.5	14.6	71.8	.48	64	2.25	69	2	958	80	95	935
Average			59.0	28	15.2	14.4	72.8	.48	64	2.47	68	2	950	83	90	924
			Lbs.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Ml.	Mg.	Cc.	Score	Score	Cc.
Minneapolis, Minn																
Do.	1HDNS	131	60.5	30	14.6	13.8	73.7	.46	63	2.50	65	1	925	90	85	895
Do.	1DNS	214	58.8	32	14.6	13.5	74.5	.47	63	2.50	62	2	895	85	95	880
Do.	2DNS	177	57.8	32	14.3	13.4	76.0	.46	63	2.75	62	2	925	90	90	875
Do.	3DNS	247	56.5	30	14.2	13.2	74.0	.48	62	3.00	62	2	910	95	90	865
Do.	1NS	160	59.0	35	13.5	12.5	73.9	.50	62	3.25	44	2	890	90	100	830
Do.	2NS	155	57.8	34	13.4	12.4	75.4	.48	63	3.25	46	2	865	90	95	825
Do.	3NS	163	56.3	35	13.6	12.6	74.8	.45	62	2.75	49	2	905	85	90	835
Average			58.1	32	14.0	13.0	74.6	.47	62	2.86	56	2	902	89	92	858

1/ These composite samples graded one grade higher than their components. Such a situation can occur whenever samples which are graded down on different factors are composited.
2/ Downgraded on account of foreign material.
3/ Downgraded on account of test weight.
4/ Downgraded on account of total damage.
5/ Downgraded on account of wheat of other classes.
6/ Downgraded on account of shrunken and broken kernels.